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INTERMITTENT DRIVING MECHANISM

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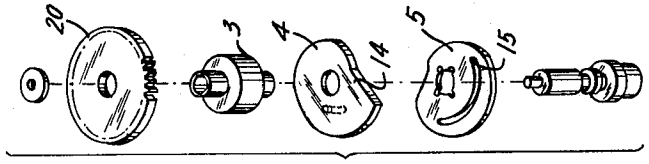



FIG. 2

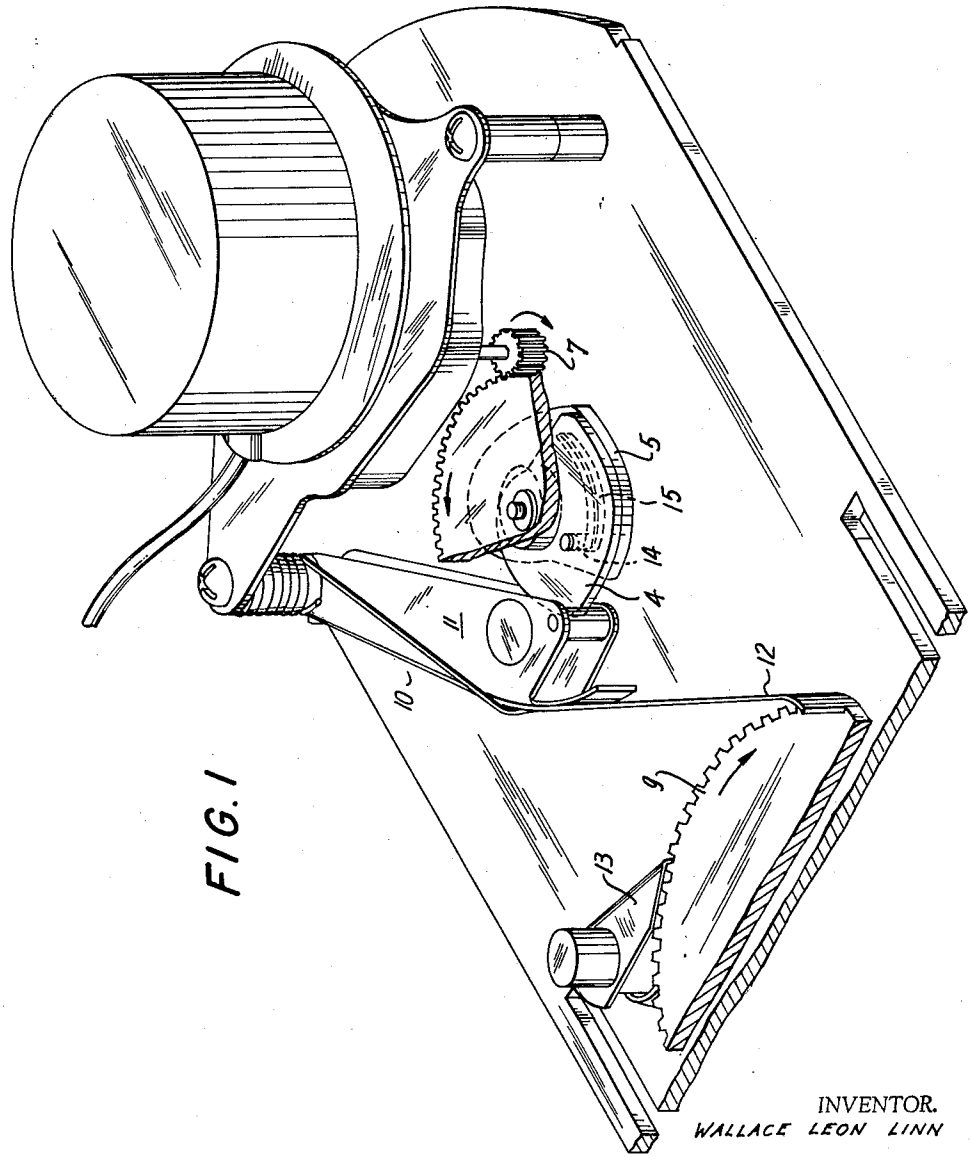



FIG. 1

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# INTERMITTENT DRIVING MECHANISM

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This invention relates generally to intermittent driving devices for moving a ratchet wheel in discrete steps at determined intervals and is particularly directed to such devices associated with timing mechanisms for activating a series of electrical circuits in a predetermined sequence.

Most intermittent driving devices used with timing mechanisms include means for the storage of energy during a wind up cycle and for releasing energy during a driving stroke; one such device has been described in Patent 2,868,026 issued to Lyman J. Finehout et al. The present invention is directed toward improvements thereon.

It is therefore an object of the present invention to provide an improved flat spring intermittent driving device.

Still another object of the present invention is to provide an intermittent advancement mechanism for driving a ratchet wheel in a constant manner; said mechanism comprising means for overcoming at least three problems found in prior cam actuated mechanisms, namely; that of the gears therein being under stress because the driver motor was used to retard the cam follower at the cam drop off point; that of creating sequencing problems in the timer since it was necessary to provide a relatively slow drop off on the cam; and that of displacing the synchronism of the motor because the motor was being overthrown.

Another object of the present invention is the provision of an improved leaf spring driving mechanism capable of a constant torque output for activating a cooperating ratchet wheel; said leaf spring driving mechanism including means to eliminate problems of gear stress, uneven sequencing of the timing pattern and the non-synchronous action of the motor associated therewith.

A further object of the invention is to provide novel and patentable cam means associated with the follower and gears of an intermittent driving mechanism used in timing devices, said cam means providing a constant and synchronous torque output.

These and other objects of the invention are pointed out in the following description in terms of the embodiment thereof which is shown in the accompanying drawings. It is to be understood, however, that the drawings are for the purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

Referring now to the drawings, FIG. 1 is a perspective view of an embodiment of the advancement mechanism invention used in a sequential timer switch disclosing the constructional and operational features thereof.

FIG. 2 is an exploded view of the novel cam assembly used in the advancement mechanism as adapted to show the constructional and cooperative arrangement of the components thereof.

Generally speaking, the present invention provides an advancement mechanism in an intermittent driving device contained in a cam operated sequential timer. The advancement mechanism includes a flat spring of substantially thin cross-section held in its lengthwise direction in a guidance cradle. This guidance cradle includes a roller which follows the dual faces or peripheral contours of an activating cam assembly. The cam assembly comprises a pair of cams, one of which is known as a "floating" cam and the other which is fixed with respect to a



driver and is known as a "driver" cam. The cams are cooperatively related so that they are moveable with respect to each other. As the cams move, a force is applied to the flat spring in a vertical direction so as to store energy supplied by the drive motor. The energy is then released in a frontal direction to move against a rachet wheel so as to drive the same in a constant manner. The cam assembly, because of the relationship of the cams, provides a mechanism for driving the toothed wheel in a manner such that overshoot and gear and bearing wear are avoided. These are effects which are normally present in cam activated intermittent driving mechanisms, but which by the present invention are avoided.

As pointed out, above, there are three fundamental problems which are usually present in prior cam activated intermittent driving devices. The problems are as follows:

A. The drive gears are under undue stress at the drop-off point of the cam follower due to the follower roller forcing the drive cam in a counter-clockwise direction. In the mechanism, the drive cam is fastened integrally to the driver gear which inturn forces the motor gearing to be used as a retarding action to prevent overthrow of the cam shaft ratchet.

B. The overthrow action necessitates a relatively slow drop-off or jump-off of the cam follower that is undesirable due to creating sequence problems in timing devices.

C. The overthrow of the motor causes the motor to be thrown out of synchronism.

Functionally, if cam **4** is disregarded, the conventional system works as follows: The synchronous motor pinion **7** will revolve in the direction shown to turn the gear **20**. Gear **20** is staked to hub **3** and drive cam **5**. When the gear is driven in the direction shown, it drives cam **5** under roller **8** of follower **11**. As the roller approaches the summit of cam **5**, it causes the follower to flex the leaf spring **12** and to transfer the driving end of the spring **12** to an adjacent (counter-clockwise) tooth valley of the ratchet **9**. A non back-up pawl **13** prevents the ratchet **9** from revolving counter-clockwise. As the cam **5** revolves past its highest point under the roller **8** and allows the roller **8** to drop to the cam's lowest point, the spring **12** is allowed to straighten from its bent position and drive the ratchet forward in a clockwise direction equal to the angular distance of the ratchet tooth. Each cycle of the cam indexes the ratchet one tooth which, in turn, imparts the same angular motion to the cam shaft assembly. The timing cams are thus moved by the cam shaft to activate the associated switches to produce the determined sequencing cycle.

In the operation, as stated above (without cam **4**), the overthrow problems are caused when the roller **8** drops down the sharp incline drop-off of cam **5**. The fast drop-off action allows spring **12** to straighten out too quickly thereby rotating the ratchet past the required one tooth increment. In addition, when the roller slides down the drop-off incline of cam **5**, the motor gearing tends to resist the overthrow action, with the possibility of causing gearing and bearing failures.

It is thus necessary that means be provided to prevent such overthrow and to restrict the tendencies which are present to create the problems of over-shoot and other deleterious effect. The new cam assembly as provided in the present invention overcomes these effects. The operation of the assembly (with cam **4** present) now acts in the nature of a governor or braking mechanism so as to control the rate of fall of the cam roller at the drop-off point. This is done by the use of a floating partial cam **4** which includes a post **14** moving within slot **15** of the fixed cam **5**. The operation of the intermittent driving device is controlled by determining the fall of rate of the

follower. Operatively, the motor pinion 7 rotates in a clock-wise direction, driving the gear 20 in a counterclockwise direction. The gear 20 is staked to a hub 3 and a partial drive cam 5. Rotation of gear 20 moves the cam 5 in a counterclockwise direction under the follower roller 8. Cam 5 remains in contact with the roller 8 for 120 degrees of the cam's periphery at which point it transfers the roller to the periphery of the retarding cam 4. At this transfer point the end of slot 15 of cam 5 has started to drive the post projection of the retarding partial cam 4, thereby forcing cam 4 to effect the transfer of the roller and the remainder of the lift cycle. Due to the driving action of cam 5 against the post projection of cam 4, cam 4 is forced to continue the lifting of the roller 8 to the summit of its periphery.

The retarding action of the roller drop-off is effected immediately after cam 4 is driven past its highest point. At this time the roller 8 starts down the incline which forces cam 4 to move in a counter-clockwise direction approximately 135 degrees, that is, to the limit of its contact with slot 15 in cam 5. This action permits the roller to drop to the lowest periphery of cam 5 and removes cam 4 from any further action until the 120 degree transfer point is reached again. The drop-off incline of cam 4 is constructed to impose a retarding action to the drop-off of the roller 8 due to its locking action effect. The principle used herein is one in which energy is absorbed in proportion to the square law function of mass movement. Thus, the energy which would normally cause the overshooting effect in moving the cam is absorbed by the relationship established between the floating and fixed cams in the cam assembly. The cam assembly acts to absorb the excessive energy and because of the retarding effect keeps the torque output constant and removes the burden from the gears and bearings used in the intermittent driving mechanism. In effect, the roller has to force the cam 4 to rotate at the drop-off point by utilizing pressure only. The drop-off is delayed sufficiently to remove shock from gears 20 and 7. The slight drop-off delay also prevents the overthrow of the ratchet by decreasing the straightening action of the drive-spring 12. In the cam assembly the retarding action may also be increased by spring loading the retarding cam 4 if desired. A tension spring member 10 is further placed against flat spring 12 so as to provide additional strength thereto.

The invention described above discloses an embodiment which can be varied without substantially changing the patentable features hereof, and accordingly, the scope hereof is to be determined by the appended claims.

What is claimed is:

1. An advancement mechanism for an intermittent timing device comprising a suitable power source, said power source having a driving means coupled to a gear train to rotatably drive said gear train, a cam assembly comprising at least two partial cams, and a gear of said gear train supported by a hub and bearing post, one of said cams being loosely fitted thereon to have a floating characteristic, another of said cams and said gear being fixed together and supported thereon, said fixedly supported cam having an arcuate slot of determined extent formed therein, said floating cam having a post fitted within said slot and being moveable along the extent thereof, said cams thus being angularly moveable with respect to each other, the peripheries of said cams individually having fall and rise contours, said contours having an overlapping relationship, a spring biased cam follower adapted to ride on said peripheral contours thereof, said spring biased cam follower moving on said rise contours on said cams for a determined portion thereof, said follower coming to a fall portion therealong, one of said cams having a peripheral contour relationship to the other cam whereby said spring biased cam follower is sufficiently retarded so as to prevent overshoot of a ratchet coupled to said spring biased cam follower and activated thereby.

2. An advancement mechanism for an intermittent timing device comprising a suitable power source, said power source drivingly connected to a gear to rotatably drive said gear, a cam assembly including at least two partial cams, means for supporting said gear and said cams above each other, one of said cams being loosely supported to move independently of said rotation of said gear, said other cam being coupled to and directly rotated as said gear is rotated, said latter cam having an arcuate slot cut therein, said first cam having a post extending into said slot and moveable therein, whereby said cam having said slot is able to move said post holding cam, said cams having an overlapped relationship angularly variable with respect to each other, each of said cams having contours defining fall and rise portions, a spring biased cam follower moveable along said contours to activate a ratchet moving means coupled to said spring biased cam follower, said spring biased cam follower dropping at said fall portions of said cam, the rate at which said spring biased cam follower drops being governed by the overlapped relationship of said cams to each other so as to regulate the force by which said ratchet is moved by said moving means.

3. An advancement mechanism for an intermittent timing device comprising a suitable power source, said power source drivingly connected to a gear to rotatably drive said gear, a cam assembly including at least two partial cams, post means for supporting said gear and said cams so that said gear is coupled to one of said cams, said cams being placed adjacent each other, one of said cams having a pin protruding therefrom, said other cam having an arcuate slot into which said pin is entered to move therealong, said cams being in an overlapped relationship to each other, one of said cams being loosely held on said post means, said other cam being rotated as said gear is rotated, said cams being shaped to have rise and drop contours, a spring biased cam follower moveable on said contours adapted to activate a ratchet moving means coupled to said spring biased cam follower, said spring biased cam follower dropping along said fall contours of said cams at a rate determined by the overlapped position of said cams whereby the force with which said ratchet moving means moves said ratchet is regulated.

4. An advancement mechanism for an intermittent timing device comprising a suitable power source, a gear drivingly connected to and rotatably activated by said power source, a pair of cams having face and drop portions formed thereon, said cams and said gear being placed on a support means, one of said cams coupled to and rotated by said gear when said gear is rotated and said one of said cams having a slot therein, said other cam being free of said rotation of said gear, said cams being adjustable with respect to each other, means on said other cam controlled by said slot of said gear rotated cam to be moved thereby, a spring biased cam follower moveable along said contours of said cams to activate intermittently a ratchet moving means coupled to said spring biased cam follower, the force by which said ratchet moving means is released depending on the overlapped relationship of said cams with respect to each other.

5. An advancement mechanism for an intermittent timing device comprising a suitable power source, gear means drivingly connected to and rotatably activated by said power source, a pair of facing cams having fall and rise contours placed above each other, one of said cams coupled to and activated by said gear means and said one of said cams having a slot therein, said other cam being free of said rotation of said gear, said cams being adjustable with respect to each other, means on said other cam controlled by said slot of said gear rotated cam to be moved thereby, a spring biased cam follower riding on said cams, ratchet activating means coupled to and controlled by said spring biased cam follower, said cams being adjustable for placing said fall contours in an overlapped relationship to each other, said spring biased cam follower

moving said ratchet activating means with a force depending upon the overlapped relationship of the fall contours of said cams.

6. An advancement mechanism for an intermittent timing device comprising a suitable power source, gear means drivingly connected to and rotatably activated by said power source, at least two cams on a post placed adjacent each other, one of said cams being coupled to and driven by said gear means, another of said cams being loosely fitted on said post, said cams having rise and fall peripheral contours angularly overlapping each other, a spring biased cam follower coupled to and thereby activating a leaf spring ratchet wheel mover, said gear driven cam having a slot cut therein and said loosely fitting cam having a post fitting within said slot whereby said latter cam is moved by said gear driven cam, said spring biased follower moving on said contours of said cam and having a downward thrust controlled by the overlapped position of said cams with said ratchet being moved with a force governed thereby.

7. An advancement mechanism for an intermittent timing device comprising a suitable power source, gear means drivingly connected to and rotatably activated by said power source, at least two cams placed on a supporting post one above the other, one of said cams being coupled to and driven by said gear means and having an arcuate slot cut for a determined extent therein, another of said cams placed thereabove having a post extending into said slot, each of said cams having rise and fall peripheral contours having an overlapped relationship therebetween, a spring biased cam follower riding thereon and activating a leaf spring, said leaf spring adapted to intermittently move an associated ratchet wheel as said gear means is activated, the ratchet wheel being moved by a force determined by the overlapped relationship of the fall contours of said cams as said follower drops therealong.

8. An advancement mechanism for an intermittent timing device comprising a suitable power source, gear means drivingly connected to and activated by said power source, a pair of predeterminedly contoured cams defining fall and rise portions held on a post, one of said cams being coupled to and driven by said gear means as said gear means is activated and one of said cams having an arcuate slot cut therein, said other cam being loosely held on said post having means insertable within said slot of said gear driven cam whereby at a determined point in the rotation of said gear driven cam said loose cam is circumferentially activated, a spring biased cam follower riding on said cams adapted to control a spring loaded leaf spring, said leaf spring moving a toothed wheel one tooth at a time, said cam follower having a rate of fall determined by the angular relationship of said fall contours of said cams with said force exerted on said wheel being regulated thereby.

9. An advancement mechanism for an intermittent timing device comprising a suitable power source having driving means coupled to a gear train to rotatably drive said gear train, a cam assembly cooperating with said gear train, said cam assembly comprising at least two partial cams, and a gear of said gear train supported by a hub and bearing post, one of said cams being loosely fitted on said hub to have a floating characteristic, another of said cams and said gear being fixed together and supported thereon, said fixedly supported cam having an arcuate slot of determined extent formed therein, said loosely fitted cam having a pin cooperating with said slot, a cam follower comprising a holding means, a post on which said holding means is rotatably mounted, a roller in said holding means placed in the free end thereof and adapted to ride on the peripheral contours of said cams, a flat leaf spring responsive to rotation of said holding means, spring means adapted to retain said leaf spring in juxtaposition with said holding means while urging said roller against said cams, a ratchet wheel connected to a shaft for moving the same, the free end of said leaf spring being directed against a tooth of said ratchet wheel so that as said cams are rotated said leaf spring is bowed so as to store energy therein, the energy so stored being released against said tooth, and said ratchet wheel being moved by a force determined by an overlapped relationship of the fall contours of said cams as said roller drops therealong.

10. An advancement mechanism for an intermittent timing device comprising a motor connected to suitable power source, said motor coupled to and moving a reduction gear train, a cam assembly cooperating with said gear train, said cam assembly comprising a gear of said gear train and a plurality of partial cams, post means for supporting said gear and said cams adjacent each other, one of said cams having a pin protruding therefrom, the other cam having a rotational slot into which said pin is entered to move therealong, said cams being in overlapped relationship to each other and having rise and fall contours, one of said cams being loosely held on said post means, said other cam being coupled to and rotated by said gear as said gear is rotated, a cam follower comprising a rectangular holding means, a post on which said holding means is rotatably mounted, a roller loosely held in the free end of said holding means and adapted to ride on the peripheral contours of said cams, a leaf spring responsive to rotation of said holding means, spring means adapted to retain said leaf spring in juxtaposition with said holding means while urging said roller against said cams, a ratchet wheel connected to a shaft for moving the same, the free end of said leaf spring being adapted to engage a tooth of said ratchet wheel, and rotation of said cams causing said leaf spring to bow and store energy therein, the energy so stored being released against said tooth to move said ratchet wheel with a force determined by the overlapped relationship of said fall contours of said cams as said roller drops therealong.

11. An advancement mechanism for an intermittent timing device comprising a suitable power source, gear means coupled to and rotatably activated by said power source, at least two cams placed on a supporting post one above the other, one of said cams being coupled to and driven by said gear means and having a rotational slot cut for a determined extent therein, another of said cams placed thereabove in a floating relationship and having a pin extending into said slot, each of said cams having rise and fall peripheral contours with an overlapped relationship therebetween, a cam follower responsive thereto and activating a leaf spring, said cam follower comprising a holding means, a post on which said holding means is rotatably mounted, a roller loosely held in the free end of said holding means and adapted to ride on the contours of said cams, means adapted to retain said leaf spring in juxtaposition with said holding means while urging said roller against said cams, a ratchet wheel connected to a shaft for moving the same, the free end of said leaf spring being adapted to engage a tooth of said ratchet wheel, and rotation of said cams causing said leaf spring to bow and store energy therein, the release of said energy being adapted to move said ratchet wheel with a force determined by the overlapped relationship of said fall contours of said cams as said roller drops therealong.

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